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Believing in climate change, but not behaving sustainably: Evidence from a one-year longitudinal study

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ABSTRACT

We conducted a one-year longitudinal study in which 600 American adults regularly reported their climate change beliefs, pro-environmental behavior, and other climate-change related measures. Using latent class analyses, we uncovered three clusters of Americans with distinct climate belief trajectories: (1) the "Skeptical," who believed least in climate change; (2) the "Cautiously Worried," who had moderate beliefs in climate change; and (3) the "Highly Concerned," who had the strongest beliefs and concern about climate change. Cluster membership predicted different outcomes: the "Highly Concerned" were most supportive of government climate policies, but least likely to report individual-level actions, whereas the "Skeptical" opposed policy solutions but were most likely to report engaging in individual-level pro-environmental behaviors. Implications for theory and practice are discussed.

1. Introduction

Although 97 percent of scientists believe in anthropogenic climate change (Cook et al., 2013), not all Americans agree; depending on the study, only 54–65% of Americans believe in climate change (Hornsey, Harris, Bain, & Fielding, 2016; Leiserowitz, Maibach, Roser-Renouf, & Hmielowski, 2012; Saad, 2017a). This skepticism has motivated researchers and policy-makers to study these beliefs because of the assumption that the Americans who believe in anthropogenic climate change should be most likely to engage in pro-environmental behaviors (Hornsey et al., 2016; Lorenzoni & Pidgeon, 2006; Pidgeon, 2012; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994). Indeed, a large body of research has focused on increasing climate change beliefs in hopes of increasing pro-environmental behavior (for recent review, see Hornsey et al., 2016). In this paper, we ask whether that assumption is supported by behavioral evidence in order to better identify psychological predictors of environmental behavior (Stern, 2011). Specifically, we conducted a longitudinal study to measure Americans' climate change beliefs, their support for pro-environmental policies, and their self-reported engagement in pro-environmental behaviors seven times over the course of one year. This allows us to examine whether beliefs correspond to behavior over time, and whether the relationship between belief and behavior varies as a function of individual differences.

Prior research yields different predictions about whether people's beliefs about climate change should correlate with sustainable behavior. Some researchers have argued that pro-environmental behavior requires that citizens believe that climate change is real (Krosnick, Holbrook, Lowe, & Visser, 2006; Schuldt, Konrath, & Schwarz, 2011). The underlying idea is that if climate change does not seem real, then people should be reluctant to think about it or take action (Akerlof, Maibach, Fitzgerald, Cedeno, & Neuman, 2013). Other research suggests that even when Americans believe in climate change, they are reluctant to take action (Hornsey et al., 2016). This apathy ostensibly occurs because they do not perceive climate change as an urgent problem (Gifford et al., 2009; Leiserowitz, 2006; Lorenzoni & Pidgeon, 2006; Pidgeon, 2012), and thus prefer to "wait and see" (Sterman & Sweeney, 2007). More generally, whether beliefs predict behavior is an ongoing, multi-decade debate in psychology (Glasman & Albarracin, 2006; Hornsey et al., 2016; Stern, 2011).

One explanation for these disparate findings is that researchers have actually been studying different people, and there is some

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evidence that this may be so. For instance, a common finding is that climate change beliefs are divided by political party and ideology (e.g., Democrat/Republican, liberal/conservative; Hornsey et al., 2016; Kahan, 2013). When examined closely, however, it seems that these dichotomized differences may be insufficient. For instance, one group of researchers argues that when it comes to climate change there are effectively four political groups in the U.S.: Democrats, Independents, Republicans, and Tea Party-Republicans, with Tea Party-leaning Americans endorsing the most distinctive views on environmental issues, including climate change (Hamilton & Saito, 2015). Another research group suggests that Americans are segmented into six distinctive groups: These Americans range from the "Alarmed" (i.e., highest belief in climate change and most concern about the issue) to the "Dismissive" (i.e., lowest climate change belief and least concern), with four intermediate groups between these extremes who vary in their endorsement of the existence of climate change, concern about the issue, and motivation to engage with the issue (Leiserowitz et al., 2012). A third typology proposes three groups - "Concerned Believers," the "Mixed Middle," and the "Cool Skeptics" (Saad, 2017b).

There is clearly considerable heterogeneity in Americans' climate change beliefs, and there seem to be somewhere between three and six different "types of Americans" - the literature has not yet reached consensus on exactly how many. Moreover, the existing typologies are all based on cross-sectional data in which participants were asked about their beliefs at a single time point. Such data is useful for beginning the process of categorizing Americans by their beliefs, but is limited in its ability to predict beliefs over time. This is in part because attitudes and beliefs may be malleable and context sensitive (Schwarz, 2007); how a person answers a question like "To what extent do you believe in climate change?" might be different in June than in January. Therefore, if we want to understand people's belief trajectories and whether they fall into some number of clusters as previous research suggests they might, it is important to take a grounded, data-driven approach, in which the same people's beliefs are measured multiple times over a long period, allowing us to examine how those beliefs naturalistically unfold over time.

To understand the implications of those belief trajectories, it is also important to measure people's behaviors over time. Due to the same methodological limitations described above, we have a limited understanding of how differences in climate change beliefs correspond to engagement in different pro-environmental behaviors. Although prior research has examined pro-environmental behaviors, this has largely been studied by measuring single-shot behaviors in laboratory settings or participants' future behavioral intentions - measures that do not always correspond to actual behaviors (Webb & Sheeran, 2006). To better understand pro-environmental behavior, more research is needed to (a) measure a broader range of behaviors, (b) measure everyday behaviors that are relevant to sustainability, and (c) assess how well those behavioral patterns correspond to individual differences, time, and other situational factors (e.g., geographic location, weather fluctuations, etc.), as decades of research from social psychology suggest they might (Ross & Nisbett, 2011).

1.1. Current study

We conducted a longitudinal study in which we measured American participants' climate change beliefs and self-reported engagement in various pro-environmental behaviors seven times (every eight weeks) throughout one year. A longitudinal approach is critical for answering several theoretical and practical questions about the relationship between climate change beliefs and pro-environmental behavior. First, it allows us to assess whether and how people's climate change beliefs change over time. To date, the literature has not shed much light on this topic, even though evidence suggests that beliefs that people report in one context are often not predictive of what they report in other contexts (Schwarz, 2007), which has important theoretical and practical implications (Schwarz & Oyserman, 2011). Longitudinal measurement can inspire greater confidence in one's results, as they are the result of repeated (and not single-point) measurements; this benefit is particularly helpful when using self-report measures, as in this study and many prior studies of climate change beliefs (e.g., Leiserowitz, 2006; Myers, Maibach, Roser-Renouf, Akerlof, & Leiserowitz, 2013).

Second, a longitudinal approach can assess whether there are individual differences in belief trajectories. Prior research has shown that climate change belief varies by individual differences (e.g., political ideology) when belief is measured at one time; however, it is possible that those individual differences have differential impacts on beliefs at different times. For example, since climate change is often associated with cues of warmth (Schuldt et al., 2011), some people may experience an unusually cold winter and interpret it to mean that climate change is a hoax (e.g., Inhofe, 2012)—thereby decreasing their belief in climate change—whereas for others the same cold weather may amplify their belief in climate change. In modern life we often observe such differences in response to climate change, but those differences are only observable when we take repeated measurements.

The third benefit of a longitudinal approach is that it allows us to assess whether pro-environmental behaviors change over time, and whether such changes follow changes in beliefs. In the same way that the beliefs observed in one context do not necessarily predict beliefs in another context (Schwarz, 2007), behavior has a similar tendency - it is heavily influenced by situational forces (Ross & Nisbett, 2011). Without longitudinal research, it is unclear whether the behaviors or behavioral intentions measured in single-shot climate surveys reflect broader patterns of behavior in society, or what influences patterns of behavior.

As outlined in the preceding paragraphs, these questions are important for advancing our understanding of psychological processes that underlie sustained engagement in pro-environmental behaviors. In addition, they are potentially informative for interventions and policies to address one of the most pressing issues of the 21st century. There is great scientific consensus on the existence of climate change (Cook et al., 2013) and the need for individuals and policymakers to take action to mitigate or adapt to its effects. What is less clear is how to successfully elicit the sustained behavioral changes necessary to achieve these broader social goals. One place to start is to measure beliefs and behaviors over time, and to allow the longitudinal data to reveal naturally occurring patterns. To do this, we used a data-driven approach of latent class growth analysis (LCGA; Jung & Wickrama, 2008; Muthén, 2001) to examine longitudinal associations between climate change beliefs and pro-environmental behaviors, then compared those patterns to patterns found in the existing literature.

2. Method

2.1. Participants

We conducted a geographically representative longitudinal study of American adults ($N = 600$; 61.67% male) recruited via Amazon Mechanical Turk (MTurk). The study—conducted from July 2014 to July 2015—assessed participants' beliefs about climate change and related factors seven times, approximately every eight weeks. Sample size was determined by funding constraints of our grant to conduct the present study, which provided us with enough

funding to recruit about 600 participants and pay them according to our payment schedule.

Our Time 1 sample was geographically diverse and comparable to the geographic distribution of the U.S. (U.S. Census Bureau, 2010). Overall, the representation of each ZIP zone was similar to the actual geographic distribution of the U.S.; two exceptions are ZIP zones 4 and 7.[2] Furthermore, the sample was geographically representative in terms of distribution across urban and rural areas. Using Urban Influence Codes (UIC; United States Department of Agriculture Economic Research Service, 2013), which classify U.S. counties into 12 groups based on population and access to economic centers, we used participants' Time 1 ZIP codes to assign a UIC. Next, we condensed these 12 categories into three groups as recommended by USDA (2013): "metro" counties, with high populations and close access to metropolitan centers; "nonmetro" counties, with moderate populations and adjacency to metropolitan or micropolitan centers; and "nonmetro noncore" counties, which cover rural or suburban areas not adjacent to metropolitan or micropolitan centers. Our sample distribution was similar to that of the U.S.: 86.3% of participants in the current sample lived in high-population counties close to economic centers ("metro"), whereas 85.0% of Americans lived in such counties as of the 2010 Census (United States Department of Agriculture Economic Research Service, 2013).

Demographically, our sample was similar to traditional MTurk samples (Casey, Chandler, Levine, Proctor, & Strolovitch, 2017): The Time 1 sample largely identified as White/Caucasian (80.5%), was generally well-educated (88.2% reporting at least some college), was young ($M_{age} = 32.1$ years), and largely identified with the Democratic Party (70.9%). A chi-square test found no relationship between political party identification and UIC (United States Department of Agriculture Economic Research Service, 2013), $\chi^2(2, N = 593) = 1.68$, $p = .431$.[3]

2.2. Recruitment strategy

Initial recruitment at Time 1 (July 2014) consisted of 604 American adults. Because climate change perceptions could differ by geographical location, attaining geographic diversity was essential. By Time 2, the sample was down to 600 participants, with four participants eliminated for various reasons: two participants' self-identifications (MTurk worker ID) could never be linked to future surveys, and two participants used the same MTurk worker ID and provided interchangeable personal details at Times 1 and 2 and did not respond when the research team sought clarification. Compensation increased progressively throughout the study to incentivize continued participation, with participants being paid: $0.50 at Time 1; $1.00 at Time 2; $2.00 at Time 3; $3.00 at Time 4; $4.00 at Time 5; $6.00 at Time 6; and $7.00 at Time 7. The follow-up surveys were only accessible to the remaining 600 MTurk workers. Please see the Supplemental Material for additional recruitment details.

2.3. Retention

Retention across the study was high: 73% ($n = 438$) of the initial 600 participants returned for Time 2 (an expected drop-off in participation; for more, see: Hansen, Tobler, & Graham, 1990; Ribisl et al., 1996), and the sample size stabilized after that, averaging 413 participants - 68.8% of the initial sample - for each survey at Times 2–7. In addition, 291 participants (48.5% of the initial sample) completed all seven surveys.

In terms of demographic predictors of retention, Time 2 retention differed by age ($F(1, 596) = 22.22$, $p < .001$, $\eta_p^2 = .04$) such that those who returned for Time 2 were slightly older ($M = 33.25$ years, $SD = 10.29$) than those who did not ($M = 29.14$ years, $SD = 7.87$); however, this was a small difference that did not span multiple generations.[4] The total number of surveys completed also differed by age ($B = 0.05$, $SE = 0.01$, $p < .001$) and political party identification, such that older participants and Republican participants completed slightly more surveys ($M = 5.45$, $SD = 2.14$) than Democrats ($M = 4.98$, $SD = 2.33$), $F(1, 591) = 4.99$, $p = .026$, $\eta_p^2 = .01$.

2.4. Procedure and measures

Upon recruitment at Time 1, all participants were informed of the longitudinal nature of the study, which involved committing to participate seven times over one year from July 2014 to July 2015. For each new survey, we messaged all participants three times: a few days beforehand to notify them of the upcoming survey; on the day of the survey launch with a link to the survey on MTurk; and the day before the survey's expiration, to remind anyone who had not yet completed the survey to do so. Each follow-up survey was available for five full days.

At Time 1 and all subsequent time points, participants completed measures in the following categories: belief in climate change (adapted from Myers et al., 2013); beliefs about causes of climate change (Leiserowitz, Maibach, & Roser-Renouf, 2010); confidence in climate change beliefs (Myers et al., 2013); perceived harm of climate change (Leiserowitz et al., 2010); personal relevance of climate change (adapted from Leiserowitz et al., 2010); personal and political efficacy (adapted from: Leiserowitz, 2006; Leiserowitz et al., 2010; Lewis & Oyserman, 2016); frequency of pro-environmental behaviors (adapted from Lewis & Oyserman, 2016); endorsement of climate change policies (adapted from Leiserowitz, 2006); trust in media and science (adapted from Leiserowitz et al., 2010); environmental identity congruence (Lewis & Oyserman, 2016); perceptions of local and national weather events (Leiserowitz et al., 2010); and demographics. During the surveys for Times 2–7, participants were also asked about: their awareness and perceptions of severe weather events in the U.S. that had occurred since the previous time point; whether their beliefs about climate change had changed; and whether their ZIP code had changed. Variables discussed in the present paper are detailed below, and details for all other measures are available in Supplemental Material.

2.4.1. Climate change belief

Participants answered on a 7-point scale (1 *definitely not happening* – 7 *definitely happening*), "Regardless of the cause, to what extent do you believe climate change is happening?"

2.4.2. Climate change causes

Participants indicated the extent to which they believed climate change was caused by (a) human activities and (b) natural causes. Both items used a scale from 1 (*not at all*) to 7 (*very much*).

[2] ZIP zone 4 includes Michigan, and we believe that we over-recruited from Michigan because potential participants who lived in Michigan were especially likely to complete our survey due to its title: Michigan Climate Attitudes Study. We have no intuition as to why ZIP zone 7 was under-represented in our sample.

[3] Seven participants declined to enter their political party preference at Time 1.

[4] This is noteworthy because some evidence suggests that younger generations are more likely to believe in climate change. Thus, a sizable age difference would have been a confounding factor in our analyses. Since there is no large age difference, we have greater confidence in the generalizability of the finding.

2.4.3. Harm

Participants responded to two perceived harm questions and two proximity of harm questions. The perceived harm questions read: "How much do you think climate change will harm people in the United States and other developed countries?" and "How much do you think climate change will harm people in developing countries?" (both from 1 *not at all* – 7 *a great deal*; correlated at Time 1 at $r = .79$, $p < .01$). The proximity of harm questions read: "When do you think climate change will start to harm people in the United States?" and "When do you think climate change will start to harm other people around the world?" (both from 1 *they are being harmed now* – 6 *never*; correlated at Time 1 at $r = .93$, $p < .001$).

2.4.4. Personal efficacy

On a scale from 1 (*strongly disagree*) to 7 (*strongly agree*), participants indicated agreement with the statement: "The actions of a single individual won't make any difference in climate change."

2.4.5. Political efficacy

Participants responded to two questions about political efficacy beliefs: "It doesn't make much difference if people elect one or another political candidate, for nothing will change" and "It's no use worrying about public policies; I can't do anything about them anyway" (both from 1 *strongly disagree* to 7 *strongly agree*, and then reverse-scored; correlated at Time 1 at $r = .65$, $p < .01$). These items were analyzed as a composite mean.

2.4.6. Pro-environmental behavior

Participants reported their frequency of engaging in the following activities (1 *never* – 4 *every opportunity I have*): recycling; using public transportation; buying environmentally friendly consumer products; and using reusable shopping bags. These four behaviors were chosen for representing a variety of behaviors that are generally accessible to people of any income or education level. The four behaviors were analyzed separately due to low internal reliability (Cronbach's α at all time points < .43).

2.4.7. Policy support

Climate change policy support was assessed from participants' support for the following policies (all from 1 *strongly support* – 7 *strongly oppose*, and then reverse-scored): reducing emissions of greenhouse gases; regulating carbon dioxide; increasing automobile fuel economy standards; increasing gasoline taxes; and redirecting fossil fuel subsidies to renewable energy sources. These five measures were chosen for representing a variety of common policies proposed by U.S. legislators concerned about climate change. Due to high internal reliability (Cronbach's α at all time points > .80), these five policy measures were combined into a single composite mean for analyses.

2.4.8. Media trust

Trust in information about climate change provided by media (newspapers, television news, radio, and other media outlets) was rated on a scale from 1 (*not at all trustworthy*) to 7 (*very trustworthy*).

2.4.9. Perceived scientific understanding

On a scale from 1 (*not at all clearly*) to 7 (*very clearly*), participants responded to the question: "How clearly do you think scientists understand climate change?"

2.4.10. Environmental identity congruence

On a scale from 1 (*not at all*) to 7 (*very much*), participants responded to five items: 1) whether one considered oneself to be an environmentalist, and whether being an environmentalist fit with one's 2) religious beliefs, 3) political beliefs, 4) moral and ethical values, and 5) being an American. These measures were analyzed as a composite mean due to high internal reliability (Cronbach's α at all time points > .86).

2.4.11. Demographics

Beyond reporting their home ZIP code, age, gender identity, and racial identification, participants reported the following demographic measures: education (7 options ranging from *less than 9th grade* to *graduate or professional degree*); annual household income (6 options ranging from *less than $20,000* to *$250,000 or more*); political liberalism (1 *not at all liberal* to 7 *very liberal*); political conservatism (1 *not at all conservative* to 7 *very conservative*); major political party affiliation (Republican or Democrat); religiosity (6 options ranging from *very religious* to *anti-religious*); and spirituality (5 options ranging from *very spiritual* to *anti-spiritual*).

3. Results

3.1. Analytic strategy

We used latent class growth analyses (LCGA) to examine whether participants' climate change belief trajectories varied systematically throughout the year, using the general belief in the existence of climate change measure. LCGA is a data-driven approach useful for identifying meaningful, more homogeneous sub-populations within a larger, heterogeneous study population (Jung & Wickrama, 2008; Muthén, 2001). This approach uncovers the growth trajectory clusters that naturally occurred in the data (Duncan, Duncan, & Strycker, 2006; Nagin, 2005), and does not reflect an *a priori* hypothesis about sub-groups within our study population. Climate change beliefs at each time point were used as indicators for latent intercept, linear, and quadratic growth factors. Once we identified distinct sub-classes (or clusters) of participants using LCGA, we then examined whether these clusters related to variables and individual differences relevant to climate change beliefs (e.g., political ideology) that have been established in previous research. Using general linear models (i.e., ANOVAs and regressions), we explored the clusters' relationships with relevant predictors and consequences. All analyses are further detailed in the Supplemental Material.

3.2. Overall trajectory of belief in climate change

Of primary interest was the level of belief in climate change—regardless of cause—over time. In addition to overall belief in climate change, participants at each time point indicated the extent to which they believed climate change was due to two specific causes: humans, or natural causes. Because believing that climate change exists could encourage pro-environmental behavior regardless of perceived cause, our analyses utilize the general measure of belief in climate change (regardless of cause); however, it is worth noting that at every time point, this measure was highly correlated with human-caused climate change belief (all $rs > .60$, all $ps < .01$) and negatively correlated with the natural-cause measure (all $rs < -.33$, all $ps < .01$).

First, although the mean levels of climate change belief were high (*intercept*, $B = 6.05$, $SE = 0.05$, $p < .001$, equates to 6 out of 7 on our scale), a simple growth curve analysis across the whole sample revealed fluctuating beliefs in climate change over the year, with significant negative slope (*slope*, $B = -0.17$, $SE = 0.04$, $p < .001$) and quadratic (*quadratic*, $B = 0.02$, $SE = 0.01$, $p < .01$) terms, suggesting that overall climate change belief decreased during winter months, and increased again during summertime. Thus, we found

longitudinal evidence consistent with prior research on the effects of temperature on climate change belief (Akerlof et al., 2013; Borick & Rabe, 2014).

3.3. Clusters of belief trajectories

Next, we found that participants subdivided into three clusters as a function of these belief trajectories. We derived solutions from one to four classes using a large number of start values (5,000 with 100 optimizations) to avoid solutions at local maxima and used 10 initial stage iterations. Based on a lower Bayesian Information Criterion (BIC = 7901.78), good entropy (.89), and significant Lo–Mendell–Rubin adjusted Likelihood Ratio test relative to the two-class model (Adj LRT = 1068.07, $p < .001$), the model with three classes was the best model for the climate change belief trajectories (see Supplemental Materials for more LCGA details). Based on the most likely latent class membership, participants were classified in one of three classes: Group 1, the "Skeptical" ($n = 56$), began with relatively indifferent beliefs about climate change at Time 1 ($M = 3.68$, $SD = 1.60$) but expressed increasing doubt about climate change through the study (*linear*: B = −0.71, $SE = 0.12$, $p < .001$; *quadratic*: B = 0.08, SE 0.02, $p < .001$); Group 2, the "Cautiously Worried" ($n = 157$), expressed beliefs in climate change at Time 1 ($M = 5.33$, $SD = 0.96$) that varied slightly by season (*linear*: B = −0.23, $SE = 0.05$, $p < .001$; *quadratic*: B = 0.03, $SE = 0.01$, $p < .001$); and Group 3, the "Highly Concerned" ($n = 387$), expressed the strongest beliefs in climate change at Time 1 ($M = 6.68$, $SD = 0.55$) and did not waver substantially throughout the study (*linear*: B = −0.03, $SE = 0.02$, $p = .14$; *quadratic*: B = −0.01, $SE = 0.01$, $p < .05$). See Fig. 1.

3.4. Predictors of cluster membership

We next assessed potential predictors of cluster membership. In the first set of analyses, we assessed the relationship between cluster membership and demographic predictors: age, gender, race, income, education, political ideology, political party identification, religiosity, and spirituality. The only significant demographic predictors of cluster membership were age (older participants were less likely to be in the "Highly Concerned" cluster; B = −0.01, $SE = 0.003$, $p = .006$) and race (those identifying as White/Caucasian were more likely to be in the "Highly Concerned" cluster; B = 0.14, $SE = 0.07$, $p = .041$). There were no relationships between cluster membership and gender, education, income, religiosity, spirituality, political ideology, or political party identification (all $ps > .53$); cluster membership also did not vary by UIC category (United States Department of Agriculture Economic Research Service, 2013), $\chi^2(4, N = 595) = 2.19$, $p = .701$.[5] In terms of retention, cluster membership did not predict differences in completing Time 2 (B = −0.04, $SE = 0.14$, Wald = 0.08, $p = .772$) or total number of surveys completed, $F(2, 597) = 0.38$, $p = .685$.

Next, we examined relationships between cluster membership and theoretically relevant self-report measures related to climate change beliefs. First, although cluster membership was differentiated using a generic measure of climate change belief (i.e., without specific causal attribution), cluster membership was highly correlated with believing that climate change was caused by humans (i.e., anthropogenic): Pearson's *r*-values ranged from .59 (at Time 1) to .72 (at Time 7). Cluster membership was also negatively associated with believing that climate change had natural causes: Pearson's *r*-values ranged from −.34 (at Time 1) to −.44 (at Time 4). Thus, cluster membership was distinguished by beliefs about anthropogenic climate change. Second, participants in higher belief clusters: expressed greater trust in climate change information from the media (B = 0.15, $SE = 0.02$, $p < .001$); perceived greater scientific understanding of the issue (B = 0.25, $SE = 0.02$, $p < .001$); perceived harm to humans in developed and developing countries alike (B = 0.30, $SE = 0.01$, $p < .001$); and perceived this harm as occurring sooner (B = −0.25, $SE = 0.01$, $p < .001$). These analyses were all validated using Mplus, details of which can be found in Supplemental Material.

Overall, participants who belonged to belief clusters that endorsed the existence of climate change and expressed concern were more likely to: be young; White/Caucasian; see climate change as anthropogenic; perceive climate change as harmful to humans around the world, soon; and be trusting of scientific and media communications about climate science. However, unlike prior research showing associations between climate change beliefs and political ideology, political party, education, and income (Hornsey et al., 2016), these attributes did not predict cluster membership in our longitudinal sample.

3.5. Belief predicts policy support but not individual behavior

Finally, we examined the consequences of cluster membership for self-reported pro-environmental behaviors and support for government policies to address climate change. We first examined differences in how often participants reported engaging in four types of pro-environmental behaviors within the previous month (recycling, using public transportation, purchasing environmentally friendly consumer products, and using reusable shopping bags) by cluster membership; notably, these behaviors were uncorrelated with participants' income or education levels at Time 1 (all $ps > .07$). Second, we examined cluster differences in support for government policies to combat climate change (reducing greenhouse gas emissions, regulating carbon dioxide, imposing vehicle emissions standards, levying increased gasoline taxes on American consumers, and redirecting federal subsidies away from fossil fuel companies and toward renewable energy sources).

We created latent constructs to assess recycling, public transportation, environmentally friendly consumer products, and reusable shopping bags during winter and summer. For each construct, we loaded self-reports from Times 1 (July 2014), 2 (September 2014), and 7 (July 2015) onto a latent factor to represent summer behaviors, and self-reports from Times 3 (November 2014), 4 (January 2015), and 5 (March 2015) onto a latent winter factor. To create factor scores, we used confirmatory factor analysis in Mplus with full information maximum likelihood estimation (i.e., enabling us to include participants who missed reports from one time point; Muthén & Muthén, 2014). This approach allowed us to generate robust within-season (i.e., winter versus summer) longitudinal constructs that harnessed the repeated-measures design, removed analytic redundancy, and reduced collinearity and number of model comparisons. Factor scores for individual participants for each of the five constructs, for both winter and summer, were extracted and saved for subsequent mixed-model ANOVAs, with belief cluster as the between-subjects factor and the two seasonal latent factors for each pro-environmental behavior or policy measure as within-subjects factors. See Table 1 for descriptive statistics for all dependent measures by belief cluster.

For pro-environmental behaviors, the results were mostly consistent. Each behavior showed significant between-subjects differences by belief cluster (recycling: $F(2, 466) = 6.43$, $p = .002$, $\eta_p^2 = .027$; public transportation: $F(2, 466) = 5.20$, $p = .006$, $\eta_p^2 = .022$; eco-friendly products: $F(2, 466) = 28.17$, $p < .001$, $\eta_p^2 = .108$; shopping bags: $F(2, 466) = 6.01$, $p = .003$, $\eta_p^2 = .025$). For

[5] Five participants inaccurately entered their Time 1 ZIP code or declined to provide it.

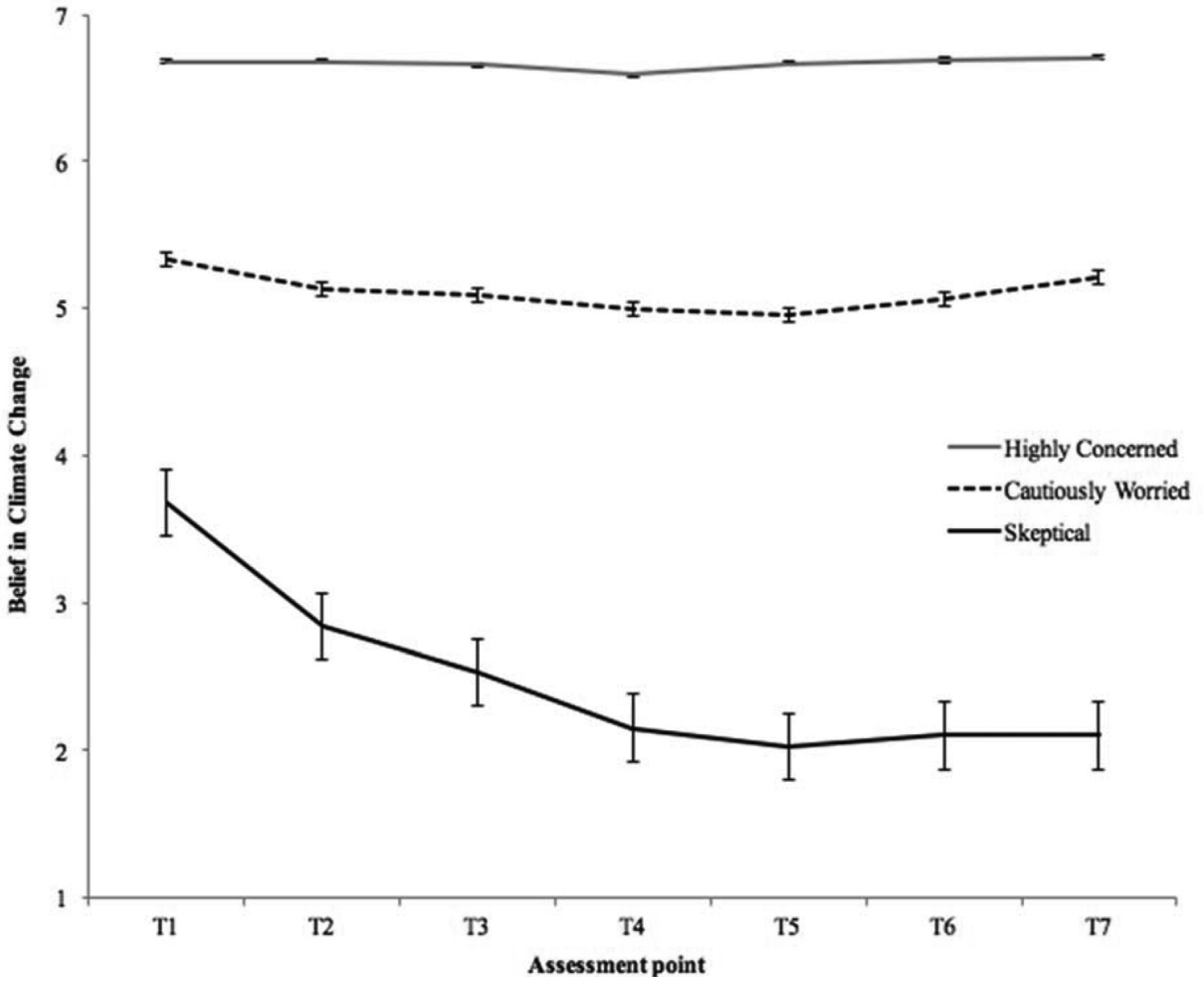

Fig. 1. Clusters of Belief Trajectories. Belief in climate change was measured on a scale from 1 (*Definitely not happening*) to 7 (*Definitely happening*) in response to the question, "Regardless of the cause, to what extent do you believe climate change is happening?" Error bars represent standard errors.

Table 1
Effects of belief cluster membership on pro-environmental behaviors and policy support.

Dependent Measure	Belief Cluster	Latent Factor Mean	Latent Factor SE	95% Confidence Interval	
				Lower Bound	Upper Bound
Recycling	Highly Concerned	0.12	0.05	0.02	0.21
	Cautiously Worried	−0.18	0.07	−0.31	−0.05
	Skeptical	−0.03	0.12	−0.26	0.21
Public Transportation	Highly Concerned	−0.05	0.05	−0.14	0.05
	Cautiously Worried	0.03	0.07	−0.11	0.17
	Skeptical	0.39	0.13	0.14	0.64
Eco-friendly Products	Highly Concerned	−0.16	0.05	−0.25	−0.08
	Cautiously Worried	0.13	0.07	−0.01	0.26
	Skeptical	0.74	0.12	0.51	0.97
Reusable Shopping Bags	Highly Concerned	−0.03	0.05	−0.12	0.06
	Cautiously Worried	−0.03	0.07	−0.16	0.11
	Skeptical	0.41	0.12	0.17	0.64
Policy Composite	Highly Concerned	0.43	0.04	0.35	0.52
	Cautiously Worried	−0.41	0.06	−0.53	−0.28
	Skeptical	−1.59	0.11	−1.80	−1.37

recycling, the "Cautiously Worried" reported significantly lower frequency of recycling than the "Highly Concerned," who did not differ from the "Skeptical"; however, for public transportation, eco-friendly products, and shopping bags, the "Skeptical" reported significantly greater behavior frequency than the other two belief clusters. (See Figs. S2–S5 in Supplemental Material for latent factor means by cluster.) Greater self-reported frequency of environmental behavior among the "Skeptical" was not associated at Time 1 with seeing environmentalism as fitting with their identity ($F(2, 597) = 47.33$, $p < .001$, $\eta_p^2 = .137$), or believing in individual efficacy ($F(2, 597) = 28.81$, $p < .001$, $\eta_p^2 = .088$) or political efficacy ($F(2, 597) = 19.02$, $p < .001$, $\eta_p^2 = .060$). For all four behaviors, there were

no significant within-subjects differences between the seasonal factors (recycling: $F(1, 466) = 0.09$, $p = .769$; public transportation: $F(1, 466) = 0.35$, $p = .554$; eco-friendly products: $F(1, 466) = 0.94$, $p = .334$; shopping bags: $F(1, 466) = 0.04$, $p = .847$) and no significant interactions of belief cluster and seasonal factors (recycling: $F(2,466) = 1.85$, $p = .158$; public transportation: $F(2, 466) = 2.99$, $p = .051$; eco-friendly products: $F(2, 466) = 1.27$, $p = .283$; shopping bags: $F(2, 466) = 0.43$, $p = .651$).

For the policy support composite measures, we found the opposite pattern. There was again a significant between-subjects effect of cluster membership: Each belief cluster reported significantly different endorsement of federal climate policies. However, unlike before, the "Highly Concerned" expressed the greatest endorsement and the "Skeptical" the least ($F(2, 466) = 176.93$, $p < .001$, $\eta_p^2 = .432$). Like behavior frequency, there were no within-subjects differences ($F(1, 466) = 1.09$, $p = .298$) nor any interaction between belief cluster and seasonal factor ($F(2, 466) = 0.02$, $p = .982$).[6] (See Fig. S6 in Supplemental Material for latent factor means and 95% confidence intervals.) Notably, policy support and pro-environmental behaviors were largely uncorrelated; for instance, at Time 1, policy support never correlated with any behavior beyond $r = .19$. (See Supplemental Material for correlation tables.)

4. Discussion

In a geographically representative longitudinal study of Americans, we found that climate change belief varies by both seasonal changes and individual differences. Specifically, our participants believed in climate change less during colder (vs. warmer) months, consistent with prior research on heat effects on climate change belief (Borick & Rabe, 2014). Belief in climate change predicted support for government policies to combat climate change, but did not generally translate to individual-level, self-reported pro-environmental behavior, consistent with a recent meta-analysis (Hornsey et al., 2016); indeed, different levels of climate change belief predicted different types of engagement (pro-environmental behavior vs. policy support). However, unlike Hornsey et al. (2016), we found that climate change skeptics were generally *more* likely to report pro-environmental behavior than their high-belief peers, but that higher belief reliably predicted support for federal climate change policies. Indeed, the effect sizes for the associations between belief cluster and policy support were generally much larger than those for relationships between belief cluster and self-reported pro-environmental behavior, indicating a more robust relationship. Nonetheless, this divergence between the low- and high-belief clusters in their self-reported pro-environmental behavior and policy support occurred consistently throughout the longitudinal study, indicating that the link between climate change belief and different categories of engagement (pro-environmental behavior vs. policy support) merits future research.

4.1. Limitations, constraints on generality, and future directions

Despite these findings about climate change beliefs, self-reported behaviors, and policy support, we were unable to explain why the "Skeptical" low-believers were more likely to self-report more pro-environmental behavior than high-believers. For instance, the "Skeptical" did not report greater identity fit with environmentalism, did not endorse greater beliefs in individual and political efficacy to reduce climate change, and were not associated with logical demographic factors (e.g., political ideology, income, education). One possibility is that our findings generalize only to Americans on MTurk who tend to lean to the political left. Although we cannot rule out this possibility until this study is replicated with other samples, the current sample contained enough conservatives to test for ideology effects; furthermore, other research has documented that conservatives on MTurk are dispositionally similar to conservatives in well-respected nationally representative samples (e.g., American National Election Study; Clifford, Jewell, & Waggoner, 2015). However, it is also possible that we did not measure partisanship or ideology with enough granularity to detect nuanced differences in climate change beliefs. Indeed, research published after we collected our data found that "Tea Party" Republicans have the most distinct environmental views (Hamilton & Saito, 2015), whereas conventional Democratic/Republican divides (our measure of partisanship) do not sufficiently capture diverse environmental views in the U.S. With more nuanced measurement of political factors, perhaps our results would be more similar to other research (e.g., Hornsey et al., 2016), and may explain why our results differ from previous typologies (e.g., Hamilton & Saito, 2015; Leiserowitz et al., 2012). For instance, it is possible that with greater differentiation of participants by political identity, we could have uncovered more belief clusters, like some previous research. However, because our methods differ substantially from other studies (i.e., longitudinal vs. cross-sectional), we cannot be sure.

Therefore, although we cannot explain the pattern of results between climate change belief clusters and self-reported pro-environmental behaviors in the present manuscript, we can offer some speculations worthy of future research. Why did the "Highly Concerned" report significantly less pro-environmental behavior than their "Skeptical" peers, despite endorsing federal climate change policies? Of course, there are limitations to self-reported behavior, which does not always correspond to objective behavior and may be influenced by factors such as social desirability bias (Kormos & Gifford, 2014). However, social desirability is an unlikely explanation for our effects: Socially desirable responding would predict that the "Highly Concerned," not the "Skeptical," would be more likely to inaccurately inflate their reporting of pro-environmental behavior. One possible explanation could again relate to measuring politics with more granularity: Perhaps our "Skeptical" participants had more libertarian leanings, leading them to report engaging in individual-level behavior over endorsing federal government climate change policies. Or, the "Skeptical" might have been motivated to report behaving pro-environmentally for other reasons that they did not associate with climate change, such as reducing pollution or waste accumulation. Other possibilities for these results involve the "Highly Concerned": Perhaps they engaged in moral licensing (Merritt, Effron, & Monin, 2010), whereby their concern about climate change psychologically liberated them from engaging in (and reporting) pro-environmental behavior. Or, perhaps the "Highly Concerned" felt that federal policies were the more effective means of addressing climate change (vs. individual pro-environmental behaviors). We cannot currently address these possibilities, but they are exciting avenues for future research.

A final future direction concerns whether certain climate change beliefs interact over time with pro-environmental behaviors and policy support, such that each reinforces the other on a cross-lagged time basis (Slater, 2007). In this scenario, individuals may engage in certain types of pro-environmental behaviors based on their climate change beliefs, which would then reciprocally reinforce those beliefs at later time points.

[6] All patterns of results for behavior and policy measures were consistent regardless of demographic and self-efficacy controls. See Supplemental Materials.

4.2. Conclusion

The present research has several implications for research about Americans' climate change beliefs. First, these beliefs vary seasonally, and belief cluster membership influences the degree of seasonal fluctuation. Those holding strong beliefs initially maintained them over time, whereas those with initially weaker beliefs were more influenced by seasons. Second, belief in climate change was predictive of federal climate policies, but not individual-level, self-reported pro-environmental behaviors. These results suggest that different groups may prefer different strategies for addressing climate change. Thus, belief in climate change does not appear to be a necessary or sufficient condition for pro-environmental behavior, indicating that changing skeptical Americans' minds need not be a top priority for climate policymakers.

Author note

The University of Michigan Institutional Review Board Health Sciences and Behavioral Sciences determined that this study was exempt from IRB oversight. We have reported all measures, conditions, and data exclusions for the studies presented in this manuscript.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jenvp.2018.03.001.

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